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CONTRIBUTIONS OF THE MEDICAL CORPS OF THE ARMY TO THE PUBLIC HEALTH LABORATORY[1]

By COLONEL EDGAR ERSKINE HUME

MEDICAL CORPS, UNITED STATES ARMY

DR. WILLIAM HENRY WELCH was a long-time friend and constant user of the Army Medical Library. Billings, its great librarian, had selected Welch for his professorship at Johns Hopkins. Not long before his last illness Dr. Welch was in the library and, in the course of one of his delightful conversations, said: "I have been asked on more than one occasion what have been the really great contributions of this country to medical knowledge. I have given the subject some thought and believe that four should be named: (1) The discovery of anesthesia; (2) the discovery of insect transmission of disease; (3) the development of the modern public health laboratory, in all that the term implies; and (4) the Army Medical Library and its Index Catalogue."

"Popsy," as he was affectionately called, was more apt to utter words of wisdom than to write them. The Librarian was so struck by this pronouncement that he reduced it to writing immediately after Dr. Welch had left. I bear witness, for I was the Librarian.

What is "the modern public health laboratory"? I assume that Dr. Welch meant not a mere building with a miscellaneous collection of apparatus, but the concept of the sum of the knowledge of chemical, physical and biological procedures which have added to our scientific knowledge or which aid in the maintenance of health of individuals and communities. In

[1] Presented at the first session of the Laboratory Section of the seventy-first annual meeting of the American Public Health Association, St. Louis, Mo., October 27, 1942.

other words, laboratory techniques of many kinds but all ultimately at the service of the health officer and his associates.

To this concept of a sum of knowledge to-day at the command of those who seek to preserve the nation's health, the Army Medical Department has made great contributions of lasting worth. Many of them are so well appreciated that they hardly require mention. Others are not always known to be contributions by the Army or its officers. To-day, when folk are thinking about their armed forces, it is worth while to review some of these contributions. My list is not an attempt at a complete catalogue. Of course, the Army can only claim credit for the work of its full-time officers or by those whose work was done while in the military service.

America's First Bacteriologist

In any consideration of the contributions of Army medical officers to laboratory procedures, one must immediately think of the great Sternberg, father of American bacteriology. George Miller Sternberg (1838–1915), who was our Surgeon General at the time of the Spanish-American War, is one of America's great scientific figures. Perhaps the best summary of his career is to be found on his monument at Arlington National Cemetery. The text was written by Dr. William Henry Welch:

> Pioneer American Bacteriologist. Distinguished by his studies of the microorganism of pneumonia and scientific investigations of yellow fever, which paved the way for the experimental demonstration of the mode of transmission of that pestilence. Veteran of three wars, brevetted for bravery in action in the Civil War and the Nes Percés War. Served as Surgeon General of the U. S. Army for a period of nine years, including the Spanish-American War. Scientist, author, and philanthropist. M.D., LL.D.

Space precludes a full account of all that Sternberg did in the way of laboratory research, but the great things are so great as to make details unnecessary. He became interested in the new science of bacteriology at its beginning. In 1881 he discovered the pneumococcus, pathogenic agent of lobar pneumonia, which he found constant in his own sputum. It was found to be identical with the organism described by Pasteur in the same year. Later, 1885, Sternberg demonstrated that his *Micrococcus pasteuri* is in fact the capsulated micrococcus found in the rusty sputum of pneumonia patients. While Frankel is entitled to credit for this important discovery, it was Sternberg who first recognized and described the organism.

In 1882, while on duty at Fort Mason, California, Sternberg demonstrated and photographed for the first time the tubercle bacillus, which had been discovered in that year by Koch. Sternberg's photomicrographs of this and other organisms are preserved in the Army Medical Museum. Many of them are unexcelled even by use of the most modern photographic apparatus and lighting devices.

His text-books on bacteriology played a most important part in the development of that science in the United States. In 1880 he translated Antoine Magnin's "Les Bactéries" (1878) from the French. In 1884, under the authorship of both Magnin and Sternberg this work was greatly enlarged and brought down to date. In 1892 there appeared Sternberg's "A Manual of Bacteriology," a milestone indeed. All these works contained many of Sternberg's own photomicrographs as illustrations.

Sternberg must also be remembered for his valuable work on the etiology of yellow fever. Though he did not discover the pathogenic agent, he was able to prove that many supposedly causative organisms were not concerned. The value of this negative work must not be overlooked. Moreover, it was Sternberg who selected Walter Reed for study of pathology of yellow fever in Welch's laboratory at Johns Hopkins. He always gave every support to Reed in his yellow fever work.

Typhoid Fever Prophylaxis

Major Walter Reed (1851–1902) is best remembered for his epidemiological studies which demonstrated that yellow fever is transmitted by the mosquito. His other great contribution to public health is almost as important—the studies of typhoid fever in the Army camps at the time of our War with Spain in 1898, which showed that the disease is transmitted not merely by contaminated drinking water, but by direct contact as well. "Food, fingers, and flies," as Osler put it, or "Dirt, diarrhea, and dinner," as Sedgwick said. Reed's associates in this work were Majors Victor Clarence Vaughan (1851–1929) and Edward Oram Shakespeare (1846–1900).

Typhoid fever is an ancient enemy of soldiers. In all our wars, prior to the first World War, it has taken terrible toll of our fighting men. Between the Spanish and World Wars something happened to reduce this incidence. It was the immunization of troops. Sir Almroth Wright, professor at the Royal Army Medical College, London, had practiced immunization by the inoculation of killed cultures of the typhoid bacillus, but in the South African War there was reported a discouraging "negative phase," so that in 1903 Wright's typhoid prophylaxis was prohibited. It was later again put into use in the British Army, but as a voluntary measure.

The United States Army was first to adopt compulsory typhoid prophylaxis. Surgeon General Robert Maitland O'Reilly (1845–1912) became interested in Wright's work and sent the brilliant Captain Frederick Fuller Russell to Europe to investigate. Russell

was then a professor at our Army Medical School, and to-day, a Brigadier-General, is professor emeritus at Harvard, having been the head of the International Health Board. Russell became convinced of the effectiveness of the practice and in 1909 was given the gigantic task of immunizing the entire United States Army against this disease. From a morbidity of 173 cases in 1909 he brought the number to nine in 1912, the strength of the army remaining about the same. In 1911 the prophylaxis became compulsory. During the mobilization on the Mexican Border, Russell vaccinated some 20,000 men against typhoid, and the only case that occurred in the camps was that of a non-vaccinated teamster.

The World War was the test of the ultimate worth of this measure. Statistics are available, but they may be summed up with the simple statement that, had the rates of the Spanish War period prevailed, we would have had not 1,572 cases of typhoid fever, but half a million!

The corollary of this is the laboratory procedure required for the production of vaccine for this universal military use. It is a huge task. Not only have the Army Medical School Laboratories manufactured all the typhoid vaccine used by our Army, but likewise that for the Navy and the Public Health Service, as well as much for the armed forces of allied nations. At the time of the outbreak of the present war, the Army Medical School was manufacturing more than 2,500 liters of the vaccine per year, enough for a million prophylaxes—an enormous quantity, but even that has had to be exceeded to meet new war needs.

Purification of Drinking Water

No activity of a modern public health laboratory is more important than the examination of water for potability. The work of Army medical officers along this line has been of exceeding importance. It has not been many years since people thought that by taste alone one might judge of the quality of drinking water. But once the danger of water-borne diseases was explained to the public they tended to attribute all intestinal disease to contaminated water.

The proper purification of drinking water therefore became a major problem, and with it the proper technique for laboratory examination of water samples. Filtration was tried at first. The Darnall Filter, devised by Brigadier-General (then Major) Carl Rogers Darnall (1867–1941), was an ingenious adaptation of the principle of mechanical filtration to field needs. Darnall made a far more important contribution to water purification, however. This was the introduction of the use of liquid chlorine for the purpose in 1910. His experimental work, upon which the method is based, was done in the laboratories of the Army Medical School, where he was professor of chemistry and of which he subsequently became the commandant. General Darnall's priority in this use of liquid chlorine is attested by basic patents in this and other countries, the validity of which has been upheld by the courts.

For chlorination of water in the field there have been a number of devices developed in the Army's laboratories. Best known, and still in regular use, is the Lyster Bag, devised by Colonel (then Major) William John L. Lyster. It is a specially woven bag of 30 gallons capacity in which chlorination is effected by the use of calcium hypochlorite. More recently a high-test hypochlorite has been adopted which is more stable and releases a greater amount of chlorine. The Lyster Bag, or modifications thereof, is used in several foreign armies and navies.

Bacteriology of Gunshot Wounds

Prior to important laboratory studies by Colonel Louis Anatole LaGarde (1849–1920) of the Medical Corps, it was commonly supposed that the great heat generated in the firing of a rifle sterilized the bullet. It was, therefore, thought that infections of gunshot wounds were due to contaminations from the clothing, the soil or other means.

Colonel LaGarde doubted this, and by means of a long series of experiments showed that an infected bullet fired from a rifle is still capable of transmitting infection to the tissues into which it strikes. LaGarde's first paper appeared in the *New York Medical Journal*, 1892. In the years following he published a large number of reports of his laboratory studies of the effect of small arms projectiles. Even now, twenty-two years after LaGarde's death, his monograph "Gunshot Injuries" (1914; second edition, 1916) is not outmoded.

More recent laboratory work in the medical side of ballistics was done by Lieutenant-Colonel Calvin Goddard, an honor graduate of the Army Medical School. Goddard is a pioneer in the identification of bullets. By means of twin comparison microscopes he shows whether the same rifle markings are found on an unknown bullet and one fired from the suspected weapon. The medico-legal importance of this work is very great. Goddard also has made extensive studies of powder marks, and other subjects connected with forensic ballistics.

In the laboratories of the Army Medical Museum and in a series of field experiments, Colonel George Russell Callender, assisted by Staff Sergeant R. W. French, has made important contributions to our knowledge of the explosive effect of high velocity projectiles.

WILLIAM BEAUMONT AND THE PHYSIOLOGY OF DIGESTION

The pioneer studies of the physiology of digestion made by Surgeon William Beaumont (1785–1853) of the Army may, at first sight, not be considered contributions to the public health laboratory. Yet they, in fact, are. Though Beaumont did his work far from the centers of medical science and in primitive cabins and tents, it was really research of the first magnitude. As already said, it is not the building that makes the laboratory.

Beaumont is one of the best known of Army medical officers because his courage and skill have somehow caught the popular imagination. Recently a painting by Dean Cornwell has depicted his sitting by the bedside of his famous patient, Alexis St. Martin, a Canadian half-breed Indian.

St. Martin was accidentally shot in 1822, a gastric fistula resulting. This never healed, so that Beaumont, under whose care the patient came, had an unusual opportunity to study the physiology of digestion at first hand. The story of Beaumont's contract with the temperamental St. Martin is one of the thrillers of medical history. The patient, for all that he was receiving a regular salary from Beaumont's slender army pay, had a way of running away, only to be discovered by the energetic and patient Beaumont, so that the studies would be resumed. Beaumont's account of his work is found in his "Experiments and Observations on the Gastric Juice, and the Physiology of Digestion" (1883). "To the bibliographer," said Osler, "there are few more treasured Americana than the brown-backed, poorly printed octavo volume of 280 pages." The pioneer physiologist of the United States, and the first to make a contribution of enduring value, his work remains a model of patient, persevering research.

When Beaumont's famous patient died in 1880, at an advanced age and the father of twenty children, Osler tried to obtain his stomach for the Army Medical Museum. But there came a telegram of warning—"Don't come for autopsy: will be killed"—and St. Martin's neighbors guarded his grave by night.

MALARIA

Malaria is a disease of the utmost interest to armies. It is perhaps the most important single cause of disability in the tropics, where our army and so many other military forces are engaged. It is interesting that the important researches as to the cause of malaria and its mode of transmission have been made by military surgeons. In 1880 Charles-Louis-Alphonse Laveran (1845–1922), a surgeon in the French Army, discovered the parasite of malaria while serving in Algeria. In the following year he described the parasites in all their aspects. In 1897 Sir Ronald Ross (1857–1932), then a Major of the Indian Medical Service, demonstrated the mosquito as the vector of malaria. On these discoveries our war on malaria is based.

The United States Army was the first to undertake anti-malarial work on a large scale. From 1898 onward our troops were given mosquito nets, on the recommendation of Major (now Brigadier-General) Jefferson Randolph Kean, and instructed in their proper use. The work of Gorgas in Cuba and later in Panama in the eradication of mosquitoes, malarial as well as those of yellow fever, is known to all and sundry.

Colonel Charles Franklin Craig first demonstrated the intracorpuscular conjugation of malarial plasmodia as the cause of latency and relapses, and of the existence of carriers.

While the extensive and efficient anti-malarial work done by the Army in the field is hardly to be called a contribution to the public health laboratory, yet much of it rests on proper laboratory identification of mosquitoes, as well as the malarial parasites themselves. Even in the present war our officers in the West Indies, under the direction of Colonel Leon Alexander Fox, have found that *Anopheles bellator,* a mosquito not hitherto incriminated, is a vector of malaria.

VENEREAL DISEASE CONTROL

The laboratory side of the Army's relentless war against venereal diseases came long after many other modes of attack had been used. The chemical laboratory has developed chemical prophylaxis for use in preventing venereal infection. This was not introduced by American medical officers, but the work of Metchnikoff and others was confirmed here, and it was the United States Army which first used this measure on a wide scale. Much research has been done in the way of searching for better chemical agents than the colloidal silver solution and the calomel ointment, and perhaps such will be successful. In the meantime, credit is due at least for effort and for disproving extravagant claims made for certain chemicals and various proprietary products.

In the serodiagnosis of syphilis the Army has done much. Wassermann's test was early tried, and the Army was among the first to require serological examinations in suspected cases of syphilis. Colonel Charles Franklin Craig has done outstanding work in this phase of serology. His monograph "The Wassermann Test" (1918) is authoritative and of lasting value.

The Kahn test for syphilis, now used in the Army together with the Wassermann test, and used in the Navy exclusively in the diagnosis of syphilis, is the

outcome of work done by Major Reuben Leon Kahn of the Sanitary Corps (Army Reserve). Though the Army can not claim any share in Major Kahn's valuable work in the development of the test that bears his name, it can take pride in its support of the work. Major Kahn for many years used to be placed on active duty as a reserve officer, in the laboratories of the Army Medical School, where studies were conducted as to the use of this test in the military service, including service in the field.

One of the first American physicians to use Salvarsan when that product, still known as "606," was brought out by Professor Paul Ehrlich, was Captain (later Colonel) Henry James Nichols. He collaborated with Ehrlich in giving practical tests of the drug in the early stages of its investigation (1910). With Craig, Nichols did a series of researches on the effect of the administration of salvarsan on complement fixation tests for syphilis.

Laboratory Work in Puerto Rico Leads to Successful War on Hookworm

In 1899 Colonel (then First Lieutenant) Bailey Kelly Ashford (1873–1934) began his laboratory studies of what was known as Porto Rican anemia or tropical chlorosis. The cause was unknown, but Ashford soon showed that it was the New World type of hookworm, *Necator americanus*. His account, in his breezy style, of his finding laboratory evidence of infestation by this helminth is interesting:

> Who had ever heard of a whole agricultural class dying of an epidemic of pernicious anemia? It was unthinkable. Hold on! Look at those eosinophiles. What are they doing so numerous in pernicious anemia? : . . Oh, yes, now I remember something I read out of a journal not long ago. A man by the name of Brown found these prominent strawberry looking eosinophiles to be increased in an infection by the worm causing pork measles. Maybe these animals have worms! And I began to laugh; but I sat up far into the night until the chilly morning land breeze began to blow. And I went to bed still intrigued with eosinophiles shooting like comets before my eyes. The idea that a frightful epidemic anemia with a high death rate might be caused by anything so commonplace as worms![2]

As a result of Ashford's findings and recommendations a campaign was begun in our newly acquired island of Puerto Rico, and the inhabitants by tens of thousands were successfully treated. Ashford's work has been duplicated in many parts of the tropical world.

Dysentery

The contributions to our knowledge of both amebic and bacillary dysentery made by Army medical officers have been many and important. As early as 1900 Acting Assistant Surgeon (now Colonel, retired) Charles Franklin Craig was writing on his laboratory and other studies of amebic dysentery as observed in the military hospital in San Francisco. Work on both forms of dysentery was begun about the same time in the Philippines by Assistant Surgeon (later Colonel) Richard Pearson Strong and Dr. William Everett Musgrave, hospital steward. One of the several types of dysentery bacillus bears the name of Colonel Strong, who isolated it in the Army's laboratory in Manila.

Colonel Craig in 1916 found that an epidemic of amebic dysentery among troops on the Mexican Border was fly-borne. This officer's monographs on amebic dysentery contain important reports of laboratory work. "The Parasitic Amœbæ of Man" (1911) and "Amebiasis and Amebic Dysentery" (1935) are valuable reference texts.

Pneumonia

Studies of pneumonia have been of interest to Army medical officers for many years. The discovery of the pneumococcus by Surgeon General Sternberg has already been mentioned. The monumental "Medical and Surgical History of the War of the 'Rebellion'" (6 volumes totaling 4,846 pages) and "The Medical Department of the United States Army in the World War" (17 volumes, totaling 160,291 pages) contain much on laboratory studies of pneumonia. In both works one finds that the Army was at the forefront of medical advance.

In 1917, at the time of the mobilization on the Mexican Border, Major (then Colonel) Henry James Nichols (1877–1927) showed by his laboratory work that the disease was principally due to Type I and Type II of the causative organism.

Since 1933 the Army has been producing pneumonia vaccine in the laboratories of the Army Medical School. It has been distributed to various governmental and other agencies for trial. Reports, though not final, are most encouraging. Pneumonia prevention by the use of Felton's polysaccharide derivative of the pneumococcus, containing a soluble substance, was begun by the Army in 1934. It was extensively tried in the Civilian Conservation Corps camps. Final data for the present war period are not yet available.

Trench Fever

In the first World War it was found that there was present an acute communicable disease, not unlike but distinct from typhus fever. Our British allies gave it the name "Trench Fever." It was found to be louse-borne. The most important studies of this "new" malady were made by the Medical Research Committee headed by the veteran scientist, Colonel

[2] "A Soldier in Science," 42–43.

Richard Pearson Strong, formerly of the Regular Army but then professor of tropical medicine at Harvard. Strong and his associates showed that the filterable infective agent is present in the blood plasma. The disease was reproduced by injections of the blood of patients, either intravenously or intramuscularly.

The U. S. Army Board for Study of Tropical Diseases

In considering the Army's contribution to the public health laboratory one is apt first to think of the Tropical Board, as it is known in the service. Some of its work is mentioned elsewhere in these notes.

With the acquisition of tropical possessions after the Spanish-American War, our Army fell heir to a new category of medical problems. Theretofore we had seen tropical diseases only in a few regions in our far South and never to the extent found in the true tropics. Surgeon General Sternberg, with his usual vision, created in 1900 the *Board for the Study of Tropical Diseases,* the work of which was done in Manila. The members of this first Board were First Lieutenant (later Colonel) Jere Black Clayton, First Lieutenant (later Colonel) Richard Pearson Strong, Acting Assistant Surgeon William Jephtha Calvert, Acting Assistant Surgeon Joseph J. Curry and Hospital Steward Dr. William Everett Musgrave. By means of laboratory research this board contributed largely to the sum of knowledge of plague, cholera, filariasis, dysentery, typhoid fever, blackwater fever, surra, smallpox and other maladies. In 1906 the members of the board were Captain Percy Moreau Ashburn and First Lieutenant Charles Franklin Craig, both later Colonels. They worked on filariasis, dengue, tsutsugamushi fever and intestinal parasitic infections.

As the years went by, the board, with various interruptions, because of what we call "the exigencies of the service," continued its work. In 1909, upon the recommendation of two of its members, Captain (now Colonel, retired) James Matthew Phalen and Captain (later Colonel) Henry James Nichols, the diet of Filipino scouts was changed, with a reduction of beriberi. Beri-beri was long the subject of consideration by the board. In 1913 Colonel Edward Bright Vedder published his valuable monograph on this disease.

In 1910 Colonel (then Major) Eugene Randolph Whitmore established the Pasteur Institute in Manila.

There is not space to consider all the diseases studied in the laboratories of the Tropical Board, many of which were little known in the continental United States, including paragonomiasis, schistosomiasis, filariasis, amebiasis, oidiomycosis, yaws, blastomycosis, sprue, aihnum, cholera, trypanosomiasis and bacillary dysentery. The board also considered certain diseases well enough known at home but which manifested other forms in the tropics, such as uncineriasis, tuberculosis and typhoid fever.

More recent members of the board, such as Colonels George Russell Callender and James Stevens Simmons, have done much valuable work in laboratory studies of tuberculosis, malaria and other diseases. Surgeon General Robert Urie Patterson removed the board from the Philippines to the Canal Zone.

Meleney has called the first two decades of the present century "The Golden Age of Tropical Medicine in the United States," for then yellow fever, malaria, hookworm infection, typhoid fever and the dysenteries were largely brought under control. Certainly the laboratories of our Army medical officers brought forth many of the discoveries to this end. They must ever be considered as leaders among our "Ambassadors in White," to use Morrow's term.

Roentgenology

Since the x-ray is an important laboratory aid to medicine and since its use has certainly resulted in improving the health of the public, it is not out of place to consider pioneer work done by the Army in this connection.

Our medical officers became interested in the new diagnostic aid immediately after Roentgen's discovery in 1895. Apparatus of various types was placed in use during our war with Spain, being chiefly employed in locating bullets. The Army was the first American group to use the x-ray on a large scale.

Alas, the Army had its martyrs to this new science, as did others. Mrs. Elizabeth Fleischmann Ascheim (1859–1905), though not a nurse, was a pioneer in roentgenological work and carried on her studies at the Presidio Division Hospital of San Francisco (now known as the Letterman General Hospital). Working without protection she fell a victim to cancer. One of our officers, Lieutenant Colonel Eugene Garland Northington (1880–1933), likewise lost his life in this way. His arms were amputated, one after the other, but even when entirely helpless, he retained his courage to the end, amid the suffering that goes with such a tragic fate.

Laboratories of the Army Medical Museum

The Army Medical Museum of Washington is not merely a place where unusual objects of medical interest are preserved and displayed. It is much more than a museum, being one of the country's important research institutions. It is the largest medical museum in America and probably in the world.

Much valuable research in pathology, bacteriology, helminthology, entomology and other sciences related to public health and preventive medicine has been

done in this great institution. The building was erected in 1887 and served for a time, not only for the Army Medical Museum and its sister the Army Medical Library, but also for the Army Medical School, when it was first established. In a small annex there are a series of rooms originally built for the bacteriological laboratories of Major Walter Reed. In the early days of bacteriology it was considered dangerous for a bacteriological laboratory to be too near to other buildings! There was still something of the old concept of infection flying through the air from the sick to the well, particularly when wafted by a malevolent breeze. These historical rooms are now used as offices by the museum.

A number of the more important clinical societies of this country place their entire pathological collections in the Army Medical Museum for safekeeping, display and study. Thus the museum has become the central point for the exchange of information and ideas. The Curator of the museum regards this as the institution's most important present function. The institutions which have thus far established Registries, as they are known, in the Army Medical Museum, are the American Academy of Ophthalmology, the American Academy of Oto-Rhino-Laryngology, the American Dental Association, the American Society of Clinical Pathologists, the American Association for Thoracic Surgery, the American Association of Pathologists and Bacteriologists, the American Urological Association and the American Academy of Dermatology and Syphilology. Here are a series of unrivaled collections of pathological material, both gross and microscopic, available to physicians everywhere.

The Army Medical Museum has, among other duties, that of making gross and histological studies of material sent for diagnosis from all stations throughout the army. When a piece of tissue, removed at biopsy, is sent to the museum for study to determine malignancy, reports are sent, where necessary, by telegraph. The museum is also prepared to aid in the identification of insects, snakes, etc. Through close cooperation with other federal agencies the museum's sphere of usefulness is widened

Laboratories of the Army Medical School

One of the most important features of the Army Medical School is its laboratories. There are excellent facilities for chemical, serological, bacteriological and other research, as well as arrangements for laboratory aids in diagnosis. Many of the Army's most important researches have been conducted here.

Elsewhere mention has been made of the preparation of vaccines at the Army Medical School. As a training center it is an indispensable cog in the machine which turns out trained medico-military personnel for the military service. Not for nothing did Professor Welch call the Army Medical School "America's oldest school of preventive medicine."

The Medical Department Equipment Laboratory

At Carlisle Barracks, Pennsylvania, in close cooperation with the Medical Field Service School, the Army maintains a laboratory for the development and testing of equipment for use by the Medical Department in the field. Many of the pieces of apparatus now in common use grew from experimental models made at this laboratory. The range of material considered is the widest. From the latest types of ambulances to new first-aid packets to be carried by the individual soldier, material has been brought out. This may not be a laboratory in the sense in which the term is used by the chemist or the bacteriologist, but it is a laboratory nevertheless, and an efficient one as well.

Aviation Medicine Laboratories

Since most aviation accidents are due to the faults of the pilot rather than the faults of the aeroplane, anything that serves to remove the chance of unfit men attempting to pilot aircraft, must be reckoned a measure of preventive medicine. Special laboratories for the study of the physiology of altitude flying and other phases of aviation have been maintained by the Army Medical Department since the first World War. Much good has resulted.

The work of such laboratories consists of research, and likewise in the training of the men who have the duty of examining flyers. Some men are physically incapable of ever becoming pilots. Others are good pilots at times only. No man is at his maximum physical efficiency all the time. The flight surgeon has the task of being sure that only physically fit men are allowed to fly.

Research on Warfare Chemical Agents

The Medical Department of the Army has nothing to do with the infliction of wounds or death, but must know how such things are brought about. Research, therefore, pertaining to the effects of warfare gases on the human or animal body is of paramount importance.

Work of this nature began with the first World War. Then defensive measures were entrusted to our branch of the military service. Through that war and in the two decades that intervened before the outbreak of the present conflict, specially qualified medical officers have devoted much time and thought to studies of warfare chemical agents.

At our Chemical Warfare School at Edgewood

Arsenal, Maryland, we have a Medical Laboratory. Therein are conducted experiments on the effect of the many kinds of warfare gases and other chemicals on the individuals and on large groups of human beings. The studies include pathology of warfare chemical wounds, chemical means of neutralizing warfare agents and the efficacy of the several types of gas masks.

Obviously work of this kind must, from its very nature, be highly confidential in times like these, but I do not exaggerate when I say that the things that our research men are doing are quite in keeping with the discoveries and advances made in other fields of scientific work.

Dental Focal Infection

It was one of the greatest military surgeons, Surgeon General Benjamin Rush (1745–1813), Signer of the Declaration of Independence, who first suggested that infected teeth might be the cause of disease. In working on problems pertaining to this, our Medical Corps and Dental Corps have worked in close cooperation.

Major Fernando Emilio Rodriguez (1882–1932), Dental Corps, and American officer born in Puerto Rico, may be regarded as the greatest contributor to dental bacteriology since Müller, the German investigator of half a century ago. His researches as to the cause of dental caries began in 1921. By the development of a special technique he was able, at the laboratories of the Army Medical School, to isolate and classify a high acid-producing group of bacteria, *Lactobacillus odentolyticus,* which he classified morphologically as Types I, II and III. He demonstrated Type III as the primary etiological agent in enamel decay, identifying the organism with the flora of the dentinal tubules in caries.

Veterinary Research

The Veterinary Corps is one of the several corps of the Medical Department of the United States Army. Medically important are certain researches by its officers, particularly its present chief, Brigadier-General Ray Alexander Kelser, into those diseases of animals which may be communicated to man.

Kelser demonstrated the transmission of equine encephalomyelitis by mosquitoes, ten species of *Aedes* already having been shown capable of such transmission. Several thousand cases occurred last year in human beings in Minnesota, the Dakotas and adjacent parts of Canada.

Kelser, a member of the Tropical Board, did important work in developing a vaccine for use against Rinderpest, long a serious disease among cattle in the Philippines. This officer also proved the supposition of Mitzmain, that *Tabanus striatus* is the vector of surra, a uniformly fatal equine disease in the Islands. A rabies vaccine, in which the virus is inactivated by chloroform, has been introduced by Kelser and has been found to be more effective than vaccine made by other methods.

Conclusion

These, then, are some of the contributions made by medical officers of your army to the mass of scientific knowledge ever available to the public health worker in his war on disease. Many others could be mentioned, but these will suffice to remind you that while our medical officers have always performed the duties expected of them in the military service they have likewise found time to do much scientific work of general value. To do this our men have had to be willing to work through long hours and to do things not required of them as mere routine. They have done so willingly and gladly, always remembering that whatever they could learn for the good of humanity was entirely in keeping with their prime military function of conserving the fighting strength of America's soldiers.

THOMAS JEFFERSON, THE SCIENTIST

By FREDERICK E. BRASCH

LIBRARY OF CONGRESS

Thomas Jefferson probably had the most forward-looking mind of his day in America. No other American of his generation so deserves to be termed pioneer, prophet and man of the age. His advocacy of democracy, education, religious toleration and the application of scientific knowledge to the common pursuits of life place him far in advance of his day. No contemporary of his, with possibly one exception, Benjamin Franklin, had so varied an interest in the pursuit of science as Jefferson. And yet, no satisfactory or full story of this interest and accomplishments has been published. There is a wealth of material available and it is therefore one proper function of this Bicentenary to reveal and evaluate Jefferson as a man of science.

Much evidence remains of his broad and analytical interest in matters of scientific import. To mention those of more lasting value, several of the various federal scientific bureaus of the United States are the direct result of Jefferson's farsightedness. Some of these bureaus had their origin while he was Secretary of State. The National Bureau of Standards is one, the germ of which originated in an elaborate report of Jefferson dated July 4, 1790, and presented to Con-

ress on July 13. This report contained suggestions of a plan for establishing uniformity in the coinage and weights and measures of the United States.

The Patent Office was virtually founded by Washington and at the time of its creation, Jefferson was Secretary of State. He became *ex officio* the Keeper of the Records of the Patents and was the most active examining member of the board and therefore its first administrator. The scientific foresight which he exercised at this time must be considered the cornerstone of our Patent System and laws. In 1806 President Jefferson made a recommendation for a Coast Survey to Congress, which took favorable action on February 10, 1807, and authorized the President to cause a survey to be made of the coasts of the United States, including islands, shoals and all other physical features deemed proper for completing an accurate chart of every part of the coast. To-day a continuation of this project is known as the U. S. Coast and Geodetic Survey. During Jefferson's second term much agitation was given to the question of establishing a first meridian within the United States. This was to be similar to the zero longitude at Greenwich, England. Jefferson's thorough knowledge of astronomy and mathematics together with the complementary subject of navigation enabled him to give much encouragement to members of Congress who wished to establish this standard longitude. These discussions led finally to the establishment of the Naval Observatory and Hydrographic Office.

Jefferson, like many of his contemporary men of science, was unusually active in noting the daily climatic changes. His observations were made with high-grade thermometers, barometers and his weather vane, laying the foundation of the U. S. Weather Bureau long before it was actually organized. His own manuscripts of those observations are still extant.

The one great passion of Jefferson for pure science is revealed in his study of paleontology. Jefferson is correctly known as the Father of American paleontology. When Jefferson went to Philadelphia to be inaugurated Vice-President, he carried with him a collection of fossil bones, together with a paper containing the results of his study which was later published in the *Transactions* of the American Philosophical Society. Jefferson apparently never took up the evolution question of his study of "antiquities" but confined himself to the acquisition of bones and the straightforward description of species. He felt that the time was not right for theories.

At his home in Monticello in Charlottesville, there are many evidences of his inventions and devices for labor-saving. The most ingenious is the weather-vane on the roof of the porch, which is connected by a rod running through to a compass on the ceiling. The compass has a pointer which shows the direction of the wind according to the position of the vane and nearby is an outside clock over the door giving the time. This same clock has a second face which is visible in the main entrance hall. It has a unique contrivance for winding which is done once a week. The arrangement is called a "fox and geese ladder." There are weights on both ends of the cable which is extended to both sides of the room. On the right wall there are marks at definite regular intervals giving the days of the week. When the clock is wound up the weights indicate Monday and by Saturday the weights have reached the floor. There is also a double-glass door between the entrance hall and another room, which can be opened or closed with one hand, thus automatically opening or closing the other half.

As a mathematician Jefferson was proficient in the use of logarithms and the study of geometry. This he was able to use in his architectural designing. Jefferson also had a keen appreciation of the advanced study of mechanics and optics which was evident in his various comments concerning Newton's "Principia."

To continue our understanding of Jefferson's encyclopedic mind he discussed in his letters the practice of medicine and vaccination as well as the practical and theoretical understanding of agriculture. He did not allow any subject to be neglected. He recognized and appreciated the difficult aspect of each study and emphasized, whenever possible, its application to technique and life. His relation to men in all walks of life, particularly to men of science, is vividly reflected in his voluminous correspondence. Jefferson's position in science was recognized and honored by his being elected president of the American Philosophical Society for five consecutive terms.

Jefferson's fine library bears testimony of his great interest in and his desire to maintain constant touch with the progress of science and technology. All his varied scientific pursuits, as evidenced by both his correspondence and his library, convey some idea of the greatness of Jefferson as a man of science and his love for the tranquil pursuit of nature's laws. Politics was a duty to perform; science was his real joy of life.

OBITUARY

CHARLES SCHUCHERT

1858–1942

PROFESSOR CHARLES SCHUCHERT, distinguished student of Earth's history, noted paleontologist and foremost paleogeographer of our times, died in New Haven, Connecticut, on November 20, 1942, at the age of eighty-four years. To the end of his days he continued his active research with a vigor and eagerness

that amazed and inspired his younger colleagues. After his eightieth birthday he completed and published two great volumes, and left a third in typescript at his death.

Professor Schuchert was born in Cincinnati, Ohio, on July 3, 1858, and grew up among the fossiliferous hills that have nurtured so many American paleontologists. His father was a manufacturer of furniture, and Charles spent his youth growing up with the business which he seemed destined to inherit. He was twenty-six years of age when the scientific instinct became too strong and he forsook the business world to become a paleontologist.

At that time he was poorly equipped for a scientific career, his formal education being limited to the sixth grade in grammar school plus a year in business college and courses in mechanical drawing in night school. But the spark of genius was there, driving him to seek his own education with eagerness and singleness of purpose. At first his reading was limited to the literature on fossil brachiopods, but gradually his interests widened, and in later years the breadth and extent of his reading were phenomenal. During the early years of his self-education, moreover, he was assistant in turn to E. O. Ulrich, James Hall, N. H. Winchell, Charles E. Beecher and C. D. Walcott. Thus he had almost twenty years of apprenticeship to great leaders of American paleontology, for the last ten of which he was assistant curator of invertebrate fossils at the U. S. National Museum. In 1904 he was called to Yale as professor of historical geology and curator of the geological collections in Peabody Museum, a post in which he earned honors and renown for himself and brought great distinction to Yale.

The range of Professor Schuchert's contributions to geology was wide, and his influence on our science will persist long after his passing. He was drawn first to paleontology through the hobby of collecting fossils in the hills about Cincinnati. From childhood he found in them an irresistible fascination, and while still engaged in the furniture business he had built up a notable cabinet of fossil brachiopods and was spending his evenings poring over such technical literature as he could find, learning to identify and classify his collections. Apprenticeship to Ulrich, and later to Hall, gave him more leisure for study and free access to great collections and fine libraries, and he set to work with amazing energy to learn all that could be known about the Brachiopoda. He had a penchant for system and orderliness that was reflected in his first large work, now a classic, entitled, "A Synopsis of American Fossil Brachiopoda, Including Bibliography and Synonymy." This work (1897) was followed shortly by the chapter on Brachiopoda for the well-known Zittel-Eastman "Textbook of Paleontology" (1900). The taxonomic scheme which he then collated from the literature included many original contributions and, with subsequent emendations by Schuchert, has remained the working scheme of all American students for now almost half a century. Two other notable volumes on this group indicate that his interest in the brachiopods persisted to the end of his life. The first of these, written with C. M. LeVene in 1929, is a catalogue of all the brachiopod genera and genotypes, and the second, published with G. Arthur Cooper in 1932, is a profound systematic revision of the genera of two important suborders, the Orthoidea and Pentameroidea. For a generation Schuchert has been the dean of American students of the Brachiopoda.

His interest in historical geology began in the study of stratigraphy, particularly of the Silurian and Devonian formations about Albany, while he was with Hall. It broadened and deepened immensely after he came to Yale and led to the publication, in 1915, of his well-known "Textbook of Historical Geology," which has since gone through four editions and has served in the training of countless students of the subject.

Professor Schuchert's most enduring fame will probably lie in the field of paleogeography. This was a new and little-explored field when he came to Yale and began teaching stratigraphy. He soon discovered that maps showing the distribution of ancient seas and lands greatly facilitated the interpretation of the stratigraphic record, and so he set about gathering data to build up such a set of maps for North America. In 1910, after nearly five years of research, he published his first results, "Paleogeography of North America," a volume with fifty maps and supporting text. This work was scarcely off the press before he was at work revising the maps and increasing their number so that each would represent a smaller unit of time and would show, in greater detail than previous maps had ever done, the outlines of the ancient lands and seas. For the rest of his life rarely a week passed that he did not modify some of these maps as he devoured the voluminous stratigraphic literature seeking new data. These working maps were the basis for those used in the several editions of his "Historical Geology" and so widely copied or adapted by others. His last great work, "The Historical Geology of North America," was prepared as a supporting text giving the basis for his final set of paleogeographic maps. The first of three large volumes of this work was published in 1935, the second in 1943, and the third was complete in typescript when he died, and, along with the maps, will be published posthumously. As the foremost exponent of paleogeography, he has left a distinct impress on the geologic literature of our times.

To his many graduate students Professor Schuchert was a foster-father and a friend, stimulating, encouraging and inspiring, both by his spoken word and by living example. He had learned the hard way, and he instilled in others a respect for hard work and a devotion to high ideals.

He was a member of many learned societies and the recipient of the highest honors his science could bestow. He was a member of the American Philosophical Society, of the National Academy of Sciences and of the Academy of Natural Sciences of Philadelphia; a fellow of the Geological Society of America and of the Paleontological Society; honorary member of the American Association of Petroleum Geologists; and a member or fellow of more than a dozen foreign societies. In 1929 he received the Hayden Gold Medal of the Academy of Natural Sciences at Philadelphia, and in 1934 he was awarded the Thompson Gold Medal of the National Academy of Sciences and the Penrose Gold Medal of the Geological Society of America. But perhaps the crowning achievement for one whom early adversity had denied so much as a high-school education, was to receive honorary degrees from New York University and Yale and Harvard.

CARL O. DUNBAR

RECENT DEATHS

ARTHUR LIVINGSTONE KIMBALL, research physicist and consulting engineer for the General Electric Company, Schenectady, N. Y., died on March 20 at the age of fifty-seven years.

DR. TRACY ELLIOT HAZEN, associate professor of botany, retired, at Barnard College, Columbia University, died on March 16 in his sixty-ninth year.

CHRISTIAN H. STOELTING, president of C. H. Stoelting and Company, Chicago, a former president of the Scientific Apparatus Makers of America, died on March 18 at the age of seventy-eight years.

THE death in his sixty-sixth year is announced on March 22 of Dr. Harry Louis Dember, visiting professor of physics at Rutgers University, formerly professor of physics and dean of the department of mathematics and physics at the Polytechnicum at Dresden.

THE *Journal* of the American Medical Association reports that special memorial services were held recently in Amasa Stone Chapel of Western Reserve University, Cleveland, for Dr. George W. Crile, who died on January 7. The speakers included Brigadier General Fred W. Rankin, Lexington, Ky., M.C., U. S. Army, president of the American Medical Association; Dr. Irvin Abell, Louisville, Ky., president of the American College of Surgeons; Dr. William E. Wickenden, president of the Case School of Applied Science and a director of the Cleveland Clinic Foundation, of which Dr. Crile was a co-founder, and Dr. Winfred G. Leutner, president of Western Reserve University.

SCIENTIFIC EVENTS

A NEW SEISMOGRAPH IN MEXICO

THE Mexican Ambassador to the United States of America announces that the State Government of Puebla, Mexico, headed by Dr. Gonzalo Bautista, has acquired an excellent Benioff vertical-component seismograph, to be installed at the National Astrophysical Observatory at Tonantzintla, State of Puebla. This instrument is now *en route* to Mexico.

The purchase of this modern seismograph was made from the National Research Council of Washington, D. C., through Dr. Harlow Shapley, director of the Harvard College Observatory, who made the necessary arrangements, in which the State Government of Puebla was represented by the Mexican Embassy in Washington.

The new seismograph is identical with the one installed in the Harvard Seismological Station; it is of the latest model available and is a valuable addition to scientific investigation in Mexico, since in the future the slightest microseisms will be recorded with absolute precision from Tonantzintla.

The close collaboration between the investigators of both countries is further strengthened by this purchase, and constitutes new evidence of the friendly ties uniting the peoples and the Governments of Mexico and the United States of America.

THE REPUBLICATION OF TECHNICAL BOOKS OF AXIS ORIGIN[1]

LEO T. CROWLEY, Alien Property Custodian, announced on March 24 that four hundred titles of individual technical books and sets of books of Axis origin are available for republication in furtherance of the war effort. Their titles were suggested by leading American scientists and librarians. Included among the titles are volumes on aviation, medicine, gas warfare, oceanography, physics, chemistry and other technical subjects.

Copyright interests in these works will be vested in the custodian for the purpose of having them republished as an aid to scientific research allied with the war effort. The custodian will seek reproduction and distribution of such works through normal pub-

[1] Statement received from the Office of War Information.

lishing channels by American publishers under licenses to be granted on May 1.

To encourage immediate republication and assure the widest possible use of scientific works, licenses will be granted on a non-exclusive basis for a five-year period. They will be royalty-free until all original costs incidental to republication have been recovered and then will bear a royalty of 15 per cent. of the list price of the works.

Licenses for republication will be granted to the publisher making the books available to the public in the shortest period of time and at the lowest list price. Information pertaining to requests for publication of each title will be made available to the publisher licensed to reproduce each work.

In many cases books with a very limited market are nevertheless of the greatest value in certain technical fields. In order to insure the most complete opportunity for prompt exploitation of the works after a license has been granted, no further license will be granted for a period of six months. Under similar licenses many sets of war-urgent scientific works aggregating approximately two hundred and fifty volumes are now being published.

It is hoped that the exploratory work done by the custodian will be of material assistance in securing immediate republication of those works most essential in the war effort. The exploratory work will be continued for such time as it may be of assistance in obtaining reproduction of such works. Copies of the listings of works are available at the Office of the Alien Property Custodian, Washington, together with a detailed statement of the policy which will be followed.

RARE CHEMICALS

THE following chemicals are wanted by the National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Dearborn and Federal Streets, Chicago, Ill.:

1. Sodium Saccharate
2. 4-methoxy-2-butanone
3. p-amino phenyl stibonate of sodium
4. Avelina Rosada (So. American drug)
5. Solanocapsine
6. Solanocapsidine
7. Alpha chloro butyric acid
8. Chloro pentonoic acid
9. Sodium Iodoacetate
10. 2-amino-heptane sulfate
11. Disodium phenyl phosphate
12. Gallium
13. Rubidium
14. Cesium
15. b-hydroxy glutamic acid
16. Alcohols or mercaptans of the aliphatic series having 20 or more carbons in the molecule

THE SOCIETY OF THE SIGMA XI

DR. HARLOW SHAPLEY, director of the Harvard College Observatory, president of the American Association of Arts and Sciences, has been elected president of the Society of the Sigma Xi, the national honorary society for the promotion of research in science.

Dr. C. Frederick Hansen, vice-president and trustee of the Grant Foundation, director of research and planning of the W. T. Grant Company, has been elected a member of the Alumni Committee for a period of five years.

Dr. Carleton C. Murdock, professor of physics at Cornell University, has been named a member of the executive committee for the same term.

The other officers of the society are:

Dr. George A. Baitsell, of Yale University, *Secretary;* Dr. George B. Pegram, of Columbia University, *Treasurer;* Dr. Carl D. Anderson, California Institute of Technology; Dr. Harvey E. Jordan, University of Virginia; Colonel C. E. Davies, American Society of Mechanical Engineers; Dr. Fernandus Payne, Indiana University; Dean Edward Ellery, Union University, all members of the *Executive Committee;* and Dr. James R. Angell, National Broadcasting Company; John C. Parker, vice-president, Consolidated Edison Company of New York; Dr. A. Elizabeth Adams, Mt. Holyoke College, and Dr. Paul R. Heyl, National Bureau of Standards, all members of the *Alumni Committee.*

A new chapter was installed at the Polytechnic Institute of Brooklyn on March 25, with Dr. Shapley and Dr. Baitsell as the installing officers. Dr. Saul Dushman, assistant director of the Research Laboratories of General Electric Company, spoke at the dinner in the evening.

A new Sigma Xi chapter at Tufts College at Medford, Mass., was installed on April 2. After a convocation in the morning and formal installation ceremonies in the afternoon, there was a dinner, followed by the installation address on "The Mathematical Nature of Modern Physical Theories," by Dr. George David Birkhoff, Perkins professor of mathematics, Harvard University.

The Radcliffe College Chapter will be formally installed on Thursday, April 15. The installation address will be made by Dr. S. Gaposchkin, of the department of astronomy, Harvard University.

Sigma Xi was founded in 1886 at Cornell University by a small group of graduates in science. Only those who have carried on original and independent investigation are eligible to membership.

Sigma Xi is now established in one hundred and twenty-five principal universities and cities throughout the country. This organization includes in its membership a large percentage of the scientific workers in all branches of natural science. The total mem-

bership is now about 50,000. Chapters elect 3,200 members and associates annually from faculties, graduate and undergraduate bodies. Sigma Xi promotes research through grants, national lectureships and publications. It publishes the quarterly, *The American Scientist*.

ISAIAH BOWMAN, PRESIDENT OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE newly elected president of the American Association for the Advancement of Science has had such important contacts with so many branches of the natural and the social sciences that any biographical sketch or introduction seems quite unnecessary. I shall, therefore, confine my remarks to a few comments which may give a more intimate picture of the character and personality of our new president.

In the depths of the early depression, the National Research Council felt the need of a strong guiding hand to steer it through financial shoals and at the same time to increase its usefulness in this time of urgent need. After careful survey of possibilities, it elected Isaiah Bowman to this post in 1933. The council immediately took on a new lease of vigorous life. At about the same time, the Federal Government was faced with the necessity of drastic curtailment of expenses, including those of its scientific bureaus. How, in spite of this, could the effectiveness of these bureaus be maintained and, if possible, increased? To this end the Science Advisory Board was invented by Isaiah Bowman and appointed by President Roosevelt. The only reason why Bowman was vice-chairman rather than chairman of this board was his own modesty in not wanting to take the headship of an organization which he himself had promoted. Though there was disappointment in failure to secure action on some of this board's important recommendations, approximately two thirds of its recommendations were put into effect and even its failures left a useful background of education of many governmental officials.

Again in this difficult period, the Johns Hopkins University sought a new head. Here again financial problems were insistent and discouraging. Furthermore, a long period of temporary administration had accumulated an unusually large number of problems to await solution by the new administration. Several years of painstaking search resulted in Isaiah Bowman's selection as the new president.

Now, in the midst of our greatest war, when travel restrictions even curtail or prevent its annual meetings, and when new problems and difficulties are encountered on every hand, the American Association for the Advancement of Science elects Isaiah Bowman to be its president.

One's first reaction to this recital might well be: "What a bear he is for punishment!" To this I subscribe, with the comment that, like the early Christian martyrs, he suffers in a good cause. Unlike them, he seems to survive. Unlike them also, he seems to enjoy it. The real answer is not that he likes punishment, but that he is ever eager to throw his tremendous energies and abilities into any importantly constructive job which needs to be done as a public service, especially when this job involves the better utilization of science and the scientific method. He reacts quickly and vigorously, and always constructively, to a challenge.

Professionally, Isaiah Bowman is a geographer, but not in the limited sense of the little girl's definition of geography as "the study that tells us what's where." It is more in the sense of that verse in the Princeton Faculty song which runs: "He tells us how the world was made, and where the Lord the sidewalks laid." Isaiah Bowman's geography includes, in a vital way, the whole gamut of natural and social science—everything in fact which affects man's life on this planet; meteorology, climatology, oceanography, transportation, engineering, soil science, anthropology, geology, biology, political economy and many other specialized fields are, to him, aspects of the great science of man's life in his environment. It is hard to conceive of any other scientific background which would so well fit a man to head a great, diverse scientific body like the American Association for the Advancement of Science.

I recall Bowman's description of his experiences as member of both the National Research Council and the Social Science Research Council. He described the meetings of the latter council as full of interest, brilliant wit and repartee by members with rich backgrounds of cultural interest. The discussions wandered far and wide from the subject at issue and the actual business transacted was slim, but the meetings were thoroughly enjoyable. In the National Research Council, on the contrary, there were no frills; business was transacted in one, two, three order with cold efficiency, and the meeting adjourned. Bowman found satisfactions, and also some defects, in both performances.

The twenty most important years of Isaiah Bowman's career as a professional geographer were 1915 to 1935 while he was director of the American Geographical Society of New York, though before this, while on the faculty of Yale University, he headed productive research expeditions in Peru and the Central Andes generally.

I refer the reader to "Who's Who in America" or to "American Men of Science" for the details of some dozen honorary degrees, some six medals (four specified as golden!) from learned societies of five nations, and membership in more national and international scientific bodies than I could count twice with the

same answer. Of particular note is his membership on such important commissions as those attached to the Peace Conference in Paris; the Red River Boundary Dispute; the Permanent International Commission, China and the United States. His publications are many and significant; their scope is suggested by such titles as Forest Physiography; The Andes of Southern Peru; The New World—Problems in Political Geography; Desert Trails of Atacama; The Mohammedan World; The Pioneer Fringe; Design for Scholarship; and so forth, plus a very large number of articles in scientific journals.

Amid all these activities and accomplishments, I suspect that, in the rare times when he can think his own thoughts about his own secret desires, these thoughts often turn to the little island on Lake Wentworth in New Hampshire where the Bowman family have had their summer camp in true woods-lover's style. Here the talented and attractive family, Isaiah and Cora Bowman and their two sons and a daughter, have come especially close to each other and to the renewing strength of Mother Nature. Here, too, a small rustic isolated shack used as a study has been the scene of high-pressure writing as well as of reading and contemplation. Perhaps the newly elected president of the American Association for the Advancement of Science may have the privilege of writing his presidential address in this safe retreat, if gas and tires hold out.

Those who have been associated with Isaiah Bowman on various assignments are unanimous, I believe, in feeling that they could ask for no better team-mate. In this spirit he is welcomed by old and new associates as he undertakes the new term of leadership of the American Association for the Advancement of Science.

KARL T. COMPTON

SCIENTIFIC NOTES AND NEWS

DR. IRVING LANGMUIR, associate director of the General Electric Research Laboratory, Schenectady, has been elected to honorary membership in the Institute of Metals, London. There are two honorary members of the institute—Professor C. A. F. Benedicks, director of the Metallographic Institute, Stockholm, and Dr. A. M. Portevin, who was professor of metallurgy in the Central School of Arts and Manufactures in Paris before the German occupation. Among past honorary members, now dead, were Sir William Crookes, Sir J. J. Thomson, Lord Rutherford, Professor G. Tammann and Sir William Bragg.

THE University of California at Berkeley has conferred an honorary degree on Dr. Samuel J. Holmes, professor of zoology, emeritus.

THE University of Santo Domingo has conferred an honorary degree on Dr. Hugh S. Cumming, director of sanitation of the Pan American Union.

A FRANKLIN MEDAL of the Franklin Institute, Philadelphia, was presented at the annual medal day ceremonies at the institute on April 1, to Dr. George Washington Pierce, Rumford professor of physics, later Gordon McKay professor of communication engineering at Harvard University, "in recognition of his outstanding inventions, his theoretical and experimental contributions in the field of electric communication and his inspiring influence as a great teacher." The medal was also awarded to Dr. Harold Clayton Urey, professor of chemistry at Columbia University, in recognition of "his discovery of an isotope of hydrogen of mass 2, which has resulted in the opening of new fields of knowledge."

Chemical and Engineering News announces that Raymond R. Ridgway, associate director of research at the Norton Company, Niagara Falls, has been selected Jacob F. Schoellkopf Medalist for 1943. This medal is awarded annually by the Western New York Section of the American Chemical Society "for distinguished research or chemical achievements by chemists of the Niagara Frontier." The medal will be presented at the May meeting of the section at which time Mr. Ridgway will give the medalist's address.

THE Hillebrand Prize of the Chemical Society of Washington for 1942 was presented on March 11 to Dr. John Frank Schairer, of the Geophysical Laboratory of the Carnegie Institution of Washington. The award is made in recognition of his work on the phase relations in multi-component silicate systems and in particular for his work on the four-component system $CaO—FeO—Al_2O_3—SiO_2$. This award is named for William Francis Hillebrand, formerly chief chemist of the National Bureau of Standards.

THE Electrochemical Society has awarded the Young Author Prize for 1942 to Dr. Sidney Speil, associate non-metals engineer of the Government Electrotechnical Laboratory at Norris, Tenn. Accompanying a cash prize is a certificate for scientific and technical books to the amount of $50. This book prize was established a year ago by Francis Mills Turner, of New York.

DR. A. L. TATUM, professor of pharmacology at the Medical School of the University of Wisconsin, is the recipient of the Charles Mickle Fellowship for 1942 of the University of Toronto in recognition of his work in the study of cocaine poisoning and its treatment, morphine addiction, the use of picrotoxin as

an antidote to barbiturate poisoning and his introduction of mapharsen for the treatment of syphilis. The fellowship is in the nature of an award, being the annual income from an endowment of $25,000.

THE Committee of the Athenaeum, London, according to *The Times*, London, has elected the following under the provisions of Rule II, which empowers the annual election by the committee of a certain number of persons of distinguished eminence in science, literature or the arts or for their public services: Sir William Stanier, scientific adviser to the Minister of Production; Sir Thomas Lewis, director of clinical research, University College Hospital; Sir Bernard Pares, lately professor of Russian history, University of London.

DR. HENRY E. CRAMPTON, professor of zoology at Barnard College, Columbia University, will retire at the close of the present academic year.

THE title of professor emeritus of botany of the University of London has been conferred on Dr. R. Ruggles Gates on his retirement at the age of sixty years. Dr. Gates is now working at the Marine Biological Laboratory at Woods Hole.

DR. L. S. PALMER, professor of agricultural biochemistry at the University of Minnesota, has been named chief of the Division of Agricultural Biochemistry.

D. C. TINGEY, associate professor of agronomy of the Utah State Agricultural College and Experiment Station, has been given leave of absence to become senior agronomist of the Bureau of Plant Industry of the U. S. Department of Agriculture in the guayule production project in California and Southwestern States.

DR. L. GRANT HECTOR, who has been engaged in electronic development work for the Office of Scientific Research and Development of the U. S. Government, has joined the staff of the National Union Radio Corporation of Newark, N. J., and Lansdale, Pa. He will direct electronic tube research and engineering activities.

DR. A. F. CAMP, horticulturist in charge of the Citrus Experiment Station, Lake Alfred, Fla., has returned recently from Argentina and Brazil, where he spent several weeks as consultant for the citrus industry there. This trip, arranged through the different state departments, was requested by the citrus growers of the countries concerned.

JOHN S. KARLING, professor of botany at Columbia University and formerly director of the chicle research work of the Tropical Plant Research Foundation, according to *Museum News*, is on leave of absence for the duration of the war to work as a botanical specialist in the latex-bearing plants of the Department of Rubber Exploration of the American Republics Aviation. He will be associated with G. H. H. Tate, formerly of the American Museum of Natural History, in exploring the little known tributaries of the Tapajoz and Madeira Rivers in Brazil for sources of wild rubber.

DR. LUTHER S. WEST, for five years head of the Division of Natural Science of the Northern Michigan College of Education, Marquette, has been granted leave of absence to accept a commission with the rank of captain as entomologist in the Department of the Surgeon General.

DR. JOSEPH B. GOLDSMITH, associate professor of histology and embryology at the School of Medicine of the University of Oklahoma, has leave of absence to become First Lieutenant in the Sanitary Corps of the Army.

DR. PAUL R. HEYL, of the National Bureau of Standards, retired, gave a lecture on March 27 before the Philosophical Society of Washington. The lecture was entitled "The Genealogical Tree of Modern Science."

DR. O. H. ROBERTSON, professor of medicine at the School of Medicine, University of Chicago, will deliver the seventh Harvey Society Lecture of the current series at the New York Academy of Medicine on April 15. He will speak on the "Sterilization of Air with Glycol Vapors."

DR. FRANK C. MANN, professor of pathology, experimental physiology and surgery of the University of Minnesota Graduate School at Rochester, delivered on March 12 the Alpha Omega Alpha lecture of the Institute of Pathology at Cleveland. He spoke on "The Value of Research in Medical Education."

DR. VINCENT DU VIGNEAUD, head of the department of biochemistry at Cornell University Medical College, addressed the Central Pennsylvania Section of the American Chemical Society on March 16 on "Transmethylation as a Metabolic Process." It was emphasized that transmethylation is the first new principle introduced into the science of nutrition since the discovery of the vitamins.

DR. W. M. STANLEY, of the Department of Animal and Plant Pathology of the Rockefeller Institute for Medical Research, addressed on March 2 the Chapter of Sigma Xi at Massachusetts State College. His subject was "Virus Diseases of Plants and Animals." On the following day he spoke at a Sigma Xi luncheon at Smith College on "Recent Developments in Virus Study."

DAVID DIETZ, science editor of the Scripps-Howard Newspapers, gave two lectures before the Council on

World Affairs in Cleveland, Ohio, speaking on February 24 on "Science and the War" and on March 3 on "Science and Post-war Reconstruction."

THE American Association of Cereal Chemists has for the second successive year chosen one of its members who has done notable work in the field of cereal chemistry to lecture on the research work in which he has been engaged before a number of the sections of the society. This year the lecturer will be Dr. John C. Baker, chief chemist of Wallace and Tiernan Company, Inc., of Newark, N. J., who has done distinguished work in the field of wheat proteins. The subject of his lecture will be "Gluten and its Relation to Flour Constituents in Bread Making." Dr. Baker is lecturing at Columbus, Ohio; Ft. Worth, Texas; Manhattan, Kans.; Winnipeg, Canada; Minneapolis, and Chicago.

PROFESSOR WILMON HENRY SHELDON, of the department of philosophy of Yale University, is delivering, beginning on April 1, the first series of Woodbridge lectures in philosophy at Columbia University. The general subject of the series is "Process and Polarity." The lectures were established in memory of Dr. Frederick J. E. Woodbridge, Johnsonian professor of philosophy at Columbia University and dean of the Graduate Faculties from 1912 to 1929. Professor Woodbridge died in 1940.

THE thirty-eighth annual meeting of the American Association of Museums, which would normally be called for this spring, will not be held in 1943 owing to the need for curtailment of travel.

THE thirty-fifth annual meeting of the American Society for Clinical Investigation, scheduled to take place on May 3 at Atlantic City, has been cancelled.

THE forty-eighth annual meeting of the Michigan Academy of Science, Arts and Letters was held in Ann Arbor on March 26 and 27.

THE Section of Physics and Chemistry of the New York Academy of Sciences will sponsor a conference on sulfonamide to be held on April 16 and 17 at the American Museum of Natural History.

THE name of the State School of Mines at Rapid City, S. Dak., has been changed to the South Dakota School of Mines and Technology.

ANNOUNCEMENT is made of the formation of a department of nutrition in the ministry of public health of the Republic of Paraguay. The unit was formed under the direction of Dr. Francisco A. Montaldo, who for two years specialized in the study of nutrition at the Institute of Nutrition at Buenos Aires on a scholarship provided by the government.

AN Emergency Food Commission "to foresee and meet situations as they arise" has been appointed by Governor Dewey of New York State. The objects of the commission are (1) to help New York farmers to attain maximum production, partly through alleviating such shortages as those in labor and machinery; (2) to assure continued shipment into the State of necessary feed and other supplies; (3) to guide adaptation of New York citizens "with foresight and common sense" to necessary changes of diet. The chairman of the commission is H. E. Babcock, of Ithaca, chairman of the Board of Trustees of Cornell University, a former president of the Grange League Federation Exchange. Dean Carl E. Ladd, of the College of Agriculture at Cornell University, is executive director. Among members of the commission is Dr. L. A. Maynard, director of the Cornell University School of Nutrition.

A GIFT from Archer M. Huntington to the state of New York of 500 acres of land, including High Tor, has been announced by Edmund W. Wakelee, president of the Palisades Interstate Park Commission. It is planned to convert the property into a bird sanctuary. The land includes the northernmost point of the Palisades and is on one of the principal migratory-bird routes of the East. It is favored as a breeding ground by several species of rare birds, including the swift duck-hawk.

THE Committee on Pharmaceutical Research of the American Pharmaceutical Association announces the availability of certain limited funds for research grants. These grants are to be made by the council of the association on the recommendations of the committee. They are to be made on the following basis: (a) the extent which the award will serve to promote pharmaceutical research; (b) whether the award supplements the laboratory program of the association; (c) the qualifications of those who will perform the work for which the award is made and the facilities of the laboratory where the research will be conducted; (d) preference will be given to applications wherein the award will supplement a contribution from the institution or laboratory in which the research will be conducted. Those interested in being considered for the above awards will please communicate with the chairman of the Committee on Pharmaceutical Research (Francis E. Bibbins, 150 West 64th Street, Indianapolis, Indiana) who will send an application blank which, when returned, will supply all the details that will enable the committee carefully to evaluate the projects listed in the application. These applications should be forwarded promptly so that they can be given early consideration.

DISCUSSION

A REPLY TO PROFESSOR WILLEM J. LUYTEN

As a college administrator, without scientific training, I would not presume to write to SCIENCE about a scientific review of a book or a discussion based upon such a review. Criticism of scientific research and text-books is valuable. It helps to correct errors; it alters false emphases; it serves to avoid misinterpretation. Without free and frank criticism it would be difficult to maintain freedom of thought, speech and research in academic circles.

Only a scientist should answer a scientist. But there is very little science in Professor Luyten's discussion and it is not inappropriate for a layman (so far as science is concerned) to reply to misquotation, misunderstanding, ignorance, innuendo and malice.

If Professor Luyten had confined himself to precise criticism of fact, as in his reference to determination of latitude by angular distance of sun or star, he would have been helpful. This is either so or it isn't. If so, Mr. Bauer will make the correction.

Professor Luyten makes factual criticism of statements referring to (1) the exact distance from the South Pole of the nearest point on the great circle route from Buenos Aires to Melbourne; (2) whether the correction of the variation of the North Star from the celestial pole can properly be termed "small"; (3) the exact date of the equinoxes; (4) the exact rotational speed of the surface of the earth at Hammerfest. These are points of fact to be weighed in the balance by the value of precise statement on the one hand as contrasted with general statements on the other in their importance as complicating or facilitating the ease of teaching. Certainly one "howler," if established, by itself does not condemn a book or series of books.

When he comes to a discussion of Renner's "The Air We Live In" (incorrectly referred to as "The Air-Age We Live In"), Professor Luyten enters the area of misquotation and misunderstanding. Professor Luyten would have the reader believe that Renner had taken the position that "the earth is not 8,000 miles but really 50,000 miles in diameter, the atmosphere ends at 21,000 miles above the solid surface because gravitation stops abruptly at that point. Oxygen and nitrogen cease to exist at altitudes higher than 80 miles, above which one finds only hydrogen and helium. At the top of the atmosphere the particles of air may be many feet apart, perhaps even miles, and the temperature up there is the same as that of interplanetary space—absolute zero. If a man were hauled up to the top of the atmosphere he would explode."

What Renner actually wrote was: "Theoretically, the atmosphere could be 21,000 miles deep because the earth's gravitation has the power to hold captive the tiny particles of air out to that distance. Whether extremely rarefied air actually does extend out to 21,000 miles, we probably shall never know. All we know at present is that the atmosphere is at least 300 miles deep with every evidence pointing to a . . . considerable distance beyond that. . . . The air simply thins out to unbelievable rarefaction." With regard to the oxygen and nitrogen "ceasing to exist," the book merely says: "The lower atmosphere may contain more heavy gases such as argon, and the upper atmosphere may contain more of the light helium. We are, as yet, not sure whether this is true or not."

Professor Renner when confronted with the criticism with regard to the temperature of the outer edge of the atmosphere, made the following statement to me: "Temperature is the measure of heat level; heat is the energy of molecular motion; out at the edge of the atmosphere, beyond the upper warm zone of rarefied gases, where there are practically no molecules of matter, it is reasonable to think that there is practically no heat. Indeed, according to H. Spencer Jones, the British Royal Astronomer, 'the black body temperature of space is only about 3° absolute.'" Whatever the facts may be, they can hardly warrant Professor Luyten's unjust conclusion that "the authors of this elementary school text do not understand the principles of the physical universe."

Professor Luyten further states that Renner-Bauer "appear to confuse the average distance apart between particles with the mean free path, and when they give the pressure exerted by the ocean on a fish at a depth of five miles as 11,458 pounds per square inch, the 8 may be correct but the 4 is certainly wrong." It is difficult to give a straightforward answer to vague innuendo of this type. The figure 11,458 was arrived at by multiplying the height of a column of water of five miles by weight per unit of volume, plus the weight of atmospheric pressure. This is merely a matter of arithmetic. It is indisputable that if a deep-sea fish is hauled quickly to the surface, it explodes. Whether the analogy is happy or not, it would seem to be indisputable that if a man were hauled rapidly up out of his atmosphere, his capillaries would rupture or explode (Latin: *explodere*—to push out) and death from bleeding would doubtless result even if he could be supplied with oxygen.

Coming to the book Professor Luyten referred to as "Human Geography and the Air Age" by Renner (correct title "Human Geography in the Air Age"), we reach a stage in the discussion which is unworthy

of a true scientist. Professor Luyten does not confine himself to the book which he is discussing. He goes out of bounds both intellectually and in matters of good taste. He refers to the author as a "great self-confessed genius" and makes it appear that "amateurs in the State Departments" is a quotation from the book in question. I have never heard Professor Renner confess himself a genius and the quotation does not appear in the book referred to. No mention is made in the book of ending all future troubles in the Balkans by giving Italy the entire Dalmatian coast. Nor is there any reference to massacres in Jugo-Slavia. Professor Renner claims to be a geographer. I know of no claim made by him as "economist, historian, political scientist, linguist and transportation expert" except that which would be made by any educated and cultured gentleman like Professor Renner. There is no statement in the book that "the British built the Suez Canal." It does state on page 18: "The British performed some continental surgery and made a bottleneck at Suez" which a fair-minded man could see might refer to the recent reconstruction of the Canal and the construction of the naval base at Alexandria.

Professor Luyten states that "to find a person who claims to be a geographer, economist, . . . stating that the Rhine Valley lies in Austria is quite a record." A good record, I should think; for the Rhine forms the border between old Austria and Switzerland for many miles.

Professor Luyten continues his departure from science and uses the method of innuendo when he states that Professor Renner "speaks feelingly about illiteracy when referring to people who do not agree with him." I find nowhere in the book that the author calls any one illiterate and certainly not because of disagreement with him. He does include a statement regarding geographical illiteracy in a quotation from the United States Commissioner of Education.

One other example of the unscientific and unfair quality of the discussion of Professor Willem Luyten is his reference to Professor Renner as "Herr Doktor." This is malicious. Professor Renner's ancestors fought in the American Revolution and he is listed in the first families of New York. Such a statement might be made in a smear campaign. It has no place in a scientific discussion.

Professor Luyten further states that the book makes reference to the General Staff as composed of "admirals, generals and similar elderly people." I can find no such statement. It does not represent Professor Renner as I know him. Indeed, I have seen a letter to Professor Renner from an Army general on the General Staff which reads: "I have completed your splendid book, 'Human Geography in the Air Age,' and want to congratulate you. I am personally urging my officers to secure copies of the book." I am able further to state that the relations between Professor Renner and the Army and the General Staff have been more cordial than Professor Luyten may suspect.

As I read the book I can find nothing that gives the impression of superiority, criticism or tragedy which Professor Luyten seems to have received from it. By means of this low form of criticism, Professor Luyten seeks to implant in the reader the suspicion that Professor Renner is anti-British, using such statements as "hated British." Quite in contrast to this, the book actually refers to "our relatives, the British." Out of whole cloth Professor Luyten invents the statement: "Mr. Renner is wont to complain about the fact that the British control all but one of the bottlenecks between oceans." What the author does say is: "Britain not only held these ocean gateways, but developed an immense navy to enforce complete control over them. This was the famous 'Pax Britannia' which gave freedom of the seas to the world for over a hundred years." No reasonable person could find any complaining in that statement.

Another malevolent statement by Professor Luyten is as follows: "The real tragedy lies in that these books come dressed up with copious references to the Civil Aeronautics Administration which will be mistaken by many still less-informed people as indication of approval by the C.A.A." This is only one additional blow below the belt struck by Professor Luyten in order to create a doubt in the mind of the reader. It seems to me that he implies that Dr. Wood, being a professor of psychology, is unfitted to participate in a project preparing books on aviation education in elementary and secondary schools; that the books were written without the cooperation of the Civil Aeronautics Administration; that the authors are "uninformed"; that the books are not yet in use "but that if they should be adopted in many schools" it would be unfortunate. The facts are: Dr. Wood is Professor of Collegiate Educational Research in Columbia University (unfortunately for us, not in Teachers College) and long a student of public school problems; the entire twenty books were based on research projects initiated and partially financed by the Civil Aeronautics Administration; (the books plainly state that they were prepared with the cooperation of the Civil Aeronautics Administration); the authors were selected because of special competence; and, as for the possibility of the books being adopted for use in schools, nearly a half million of them have been in use for some time and they are being called for as fast as they can be printed.

As a matter of general interest, it may be stated

here that the entire series was produced as a war emergency measure at the urgent request of a prominent government official. The authors' expenses were paid, but these authors waived all royalty rights in the interest of the war effort. The Macmillan Company cooperated by publishing and distributing the books at phenomenally low prices. Teachers College added its contribution by donating the time of staff members, contributing library service and space, workshop and laboratory quarters, and by carrying the cost of conducting courses in Aviation Education. The books were written in ninety days and published in slightly less than sixty days—five months in all—in order to meet the government's deadline. Prices run from 15 cents to 99 cents for sizable cloth-bound volumes. This breaks all previous records for book production and also for hard work. It was necessary, however, in order to meet the war emergency. The emergency was met and the results have been greater even than anticipated. Education can well be proud of the whole accomplishment. To attempt to smear such an effort can serve no good purpose.

It is to be expected that errors will be found. It is proper and useful that scholars should point them out. Professor Renner, and the other authors of the Air-Age Education Series will correct in future editions mistakes of fact, emphasis or taste. Discussion is welcome; but this does not mean that worthy, industrious, patriotic and informed workers should be subjected to malice and abuse.

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SCIENTIFIC BOOKS

ELECTROPHORESIS OF PROTEINS

Electrophoresis of Proteins and the Chemistry of the Cell Surfaces. By HAROLD A. ABRAMSON, LAWRENCE S. MOYER and MANUEL H. GORIN. 328 pp. Reinhold Publishing Corporation. 1942. $6.

ALTHOUGH the discovery of the electrophoresis of protein-coated particles was made as early as the beginning of the nineteenth century, the application of this important method to the study of proteins was limited owing to its lack of resolving power. Recently, Arne Tiselius introduced great improvements in electrophoretic methods using the moving boundary technique. The most important contribution of his method lies in its ability to resolve a soluble mixture of proteins into separate components. In this way, one or more biologically active protein fractions can be identified, and in many cases, it is possible to isolate them as electrically homogeneous individuals. A well-known example is the identification and isolation of antibody as the gamma globulin fraction in the sera of immune animals. More recently, Longsworth has added other important improvements which further increase the resolving power. During the past few years, many biologically active proteins have been examined by electrophoretic analysis with the moving boundary method to determine electrochemical homogeneity and to obtain information which might facilitate chemical isolation. In fact, the method has become one of the powerful tools in many fields of research.

Therefore, there is a timely need for a book on the electrophoresis of proteins. Abramson, Moyer and Gorin have written such a book with the aim of fitting "the needs of investigators in diverse fields, such as biology, chemistry, medicine and physics."

The text may be divided into four parts, the first of which comprises a brief historical background together with an elementary but adequate presentation of the general principles of electrophoretic migration in liquids. It also includes two chapters (5 and 6) dealing with more theoretical discussion which, however, is inconsequential to biologists interested in using electrophoresis as a tool. These chapters are included apparently for physical chemists. In the second part, both the microscopic method and the moving boundary method are described in great detail. The third section of the book deals essentially with the results of electrophoretic studies on proteins and other colloidal substances. Although the list of proteins examined is rather complete, the authors make no distinction in the text as to which of the above-mentioned methods has been employed. The remaining part of the book (Chapter 14) deals briefly with the "Surface Chemistry of Cells."

It is obvious that in a small volume of three hundred and twenty-eight pages, all these topics can not be treated very critically and precisely. This will not be wholly to the liking of the investigators in specialized fields. A few examples may be mentioned. The phrase "follicle stimulation in the male" (p. 274), would be rejected by endocrinologists as meaningless. The lack of clarification of the terms, "iso-ionic point" and "iso-electric point," would meet the disapproval of physical chemists. The omission of important chemical aspects in the discussion of "Antigen, Antibody, and Their Reactions" (Chapter 8) would be questioned by immunologists. To these criticisms, one might add that there are numerous errors in composition and printing. For example, in the text of page 69 a description of the optical arrangement of Svensson is referred to "28a," which actually is an

electrophoretic pattern of normal human plasma. Svensson's arrangement is apparently missing in the book.

In spite of such errors and oversights, Abramson, Moyer and Gorin's book on the electrophoresis of proteins represents a compilation of data on the electrophoretic analysis of proteins useful to all investigators of proteins.

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CHEMISTRY OF DENTAL MATERIALS

Outline of the Chemistry of Dental Materials. By LAURENCE G. WESSON, research biochemist, Forsyth Dental Infirmary for Children, Boston, Massachusetts. 106 pp. 5×7.5. St. Louis: The C. V. Mosby Company. 1942. $1.50.

THIS book contains a concise review of some of the properties and uses of materials employed in dental practice. The chemical changes which many of these materials undergo and their effects on the oral tissues are clearly, although briefly, described. Such topics as the chemistry of vulcanization, and the formation of polymethyl methacrylate resin, which is used as a substitute for vulcanite in artificial dentures, will be of interest to the dentist. The sections on dentifrices, dental cements, the action of ammoniacal silver solution and photography should prove of value.

The dental section of the book is preceded by an elementary review of some of the principles of chemistry. Although brief, this material should be helpful to the dental practitioner. The descriptions of such topics as the nitrogen cycle and the potential acidity and alkalinity of food, although of general interest, could well have been omitted in a book of this type.

This outline should also prove useful as a supplementary text in courses for dental hygienists.

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SPECIAL ARTICLES

THE EFFECT OF TRYPTOPHANE DEFICIENCY ON REPRODUCTION[1]

PREVIOUS reports from this and other laboratories[2-7] have shown that tryptophane deficiency induces loss of weight, alopecia, cataract formation, corneal vascularization, defective dentition, testicular atrophy, hypoproteinemia and hypochromic anemia.[8] The present report describes observations we have made on the effect of a tryptophane deficient diet on the reproductive function in female rats.

Normal adult male and female rats from a hybrid albino and hooded Norwegian rat colony were maintained on stock diet and mated. As soon as vaginal smears showed the presence of sperm the females were segregated in individual cages and were fed a tryptophane deficient diet[7, 8] *ad libitum*. The data given in Table 1 show that all the rats on the deficient diet failed to cast a litter in contrast to a group of animals continued on the control diet all of which reproduced normally. The animals on the deficient diet were kept on it for 35 to 40 days. All of them lost weight and it was notable that symptoms of tryptophane deficiency developed earlier in these animals than in unmated rats on a tryptophane deficient diet. For example, alopecia, which in our experience is rarely evident before 60 days on the deficient diet, was very evident within 30 days in the present group of animals. Corneal vascularization was likewise well developed early in the deficiency period.

TABLE 1

THE EFFECT OF TRYPTOPHANE DEFICIENCY ON THE WEIGHT AND SIZE OF LITTER OF THE PREGNANT RAT

Group	Animal number	Initial body weight	Weight change for gestation period	Average daily food intake	Gestation period	Size of litter
		gms.	*gms.*	*gms.*	*days*	
Control	PCTH–3	201	+29	9.3	22	9
	PCTH–4	168	+43	7.6	23	6
	PCTH–5	209		7.7	22	7
	PCTH–6	221	+30	6.9	24	6
	PCTH–7	187	+41	9.2	22	8
	PCTH–8	208	+37	10.0	22	10
	PCTH–9	263	+27	10.0	22	10
	PCTH–10	232	+11	9.9	30	4
Deficient*	PTH–2	211	−40	9.1		0
	PTH–3	208	−13	8.0		0
	PTH–6	193	−63	8.0		0
	PTH–7	219	−24	7.6		0
	PTH–8	199	−29	8.9		0
	PTH–11	242	−43	6.9		0
	PTH–12	220	−40	7.0		0
	PTH–13	219	−22	9.7		0
	PTH–15	228	−35	9.6		0

* The weight change determined as of the 22nd day after insemination.

In order to determine the fate of the fetus in these deficient animals a second experiment was carried out similar to the above in which female litter-mates were

[1] This investigation was aided by grants from the Rockefeller Foundation, Merck and Company and E. R. Squibb and Sons.

[2] E. G. Willcock and F. G. Hopkins, *Jour. Physiol.*, 35: 88, 1906.

[3] E. Abderhalden, *Ztschr. Physiol. Chem.*, 83: 444, 1913.

[4] R. S. Alcock, *Physiol. Rev.*, 16: 1, 1936.

[5] P. B. Curtis, S. M. Hauge and H. R. Kraybill, *Jour. Nutr.*, 5: 503, 1932.

[6] J. R. Totter and P. L. Day, *Jour. Nutr.*, 24: 159, 1942.

[7] A. A. Albanese and W. H. Buschke, SCIENCE, 95: 584, 1942.

[8] A. A. Albanese, L. E. Holt, Jr., C. N. Kajdi and J. E. Frankston. *Jour. Biol. Chem.*, in press.

placed on the deficient diet after mating. These animals were then sacrificed on the 9th, 11th, 13th and 14th days after insemination, and the uteri examined. It was found that embryos of normal size and appearance were present on the 9th day, whereas by the 14th day almost complete resorption had occurred, the embryonic masses being then scarcely discernible. A similarly treated control animal sacrificed on the 14th day of gestation showed twelve normal sized embryos.

It would appear from the above experiments that tryptophane is a most important dietary essential for normal gestation and that the available stores of the adult female rat are depleted in the course of ten days of a tryptophane deficient regimen.

We have found no reports in the literature dealing with the effect of tryptophane deficiency on the female reproductive function. However, numerous studies are to be found[9] on the deleterious effects of low protein diets on the reproduction of farm animals, and Guilbert and Goss[10] have shown that feeding a low protein diet to female rats results in reproductive failure. In the light of our findings it is pertinent to raise the question whether these effects of a low protein diet may be attributed to a low tryptophane intake.

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INFLUENCE OF FEVER UPON THE ACTION OF 3,3′-METHYLENE-BIS-(4-HYDROXY-COUMARIN) (DICUMAROL)

FOLLOWING the isolation and synthesis of the anticoagulant Dicumarol (3,3′-methylene-bis-(4-hydroxycoumarin) by K. P. Link and collaborators,[1,2] this drug has rapidly gained the attention of scientists and clinicians alike. Since this drug will frequently be used in conditions accompanied by fever, it appeared desirable to investigate the influence of higher body temperatures upon its action. It is well known that biochemical reactions are accelerated by increase in temperature, but the degree of this acceleration varies greatly from instance to instance, depending on the type, and may show unexplained abnormalities.[3]

Fever was induced in rats by the injection of a yeast suspension or typhoid vaccine which resulted in a marked rise of temperature 5 to 15 hours later. If necessary, a second injection was made. Twelve hours after the administration of the pyrogenic agent, the rats were fed 2.5 mg Dicumarol orally. Prothrombin time was determined in 12.5 per cent. plasma 24 hours after Dicumarol administration, using the method described by Link and associates.[4] In normal rats this dose of Dicumarol raises the prothrombin time from about 45 seconds to 1 minute, 47 seconds. Fever alone causes no or only a very slight increase in prothrombin time. However, animals having received Dicumarol during fever showed a tremendous increase of the prothrombin time as compared with the rats having a normal temperature.

TABLE 1

EFFECT OF 2.5 MG DICUMAROL IN RATS (PROTHROMBIN TIME OF 12.5 PER CENT. PLASMA 24 HOURS AFTER ADMINISTRATION)

	Group				
	A	B	C	D	E
Maximal rectal temperature (°F)	99.2 ± .3	100.3 101.0	101.2 102.0	102.2 103.0	103.2 104.0
Number of animals..	9	7	10	7	11
Prothrombin time ...	1′47″	4′06″	5′55″	6′10″	8′55″
Standard error	0′10″	0′25″	0′50″	1′04″	0′56″
Group A : Normal rats		Group B–E : Rats in fever			

The degree of this increase of the prothrombin time varied considerably but tended to become more pronounced with higher temperatures. A response to Dicumarol falling within the limits of normal variation occurred only three times among the rats in the stage of fever. To facilitate tabulation the value of 12 minutes was deliberately attributed to experiments in which clotting was delayed for an indefinite period in excess of 12 minutes. This occurred once in Group C and D and five times in Group E. For classification we used the maximal temperature attained during the experiment. Due to the variation of the response and the necessary deliberate form of classification, the standard error of the single groups is considerable, but statistical evaluation has shown that the differences between normal and pyretic rats are significant.

Details and further work in which changes in the metabolic rate were produced by increasing the environmental temperature or by other methods will be reported later. As far as we know, no definite observations of this type have been published so far. Our observations suggest that the administration of this drug should be particularly watched in patients having an increased body temperature, to avoid a dangerous depression of the prothrombin level.

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[9] U. S. Dept. of Agriculture, "Food and Life," pp. 476–491. Washington, D. C., 1939.

[10] H. R. Guilbert and H. Goss, *Jour. Nutr.*, 5: 251, 1932.

[1] Harold A. Campbell and K. P. Link, *Jour. Biol. Chem.*, 138: 1, 21, March, 1941.

[2] M. A. Stahmann, C. J. Huebner and K. P. Link, *Jour. Biol. Chem.*, 138: 2, 513, April, 1941.

[3] R. K. Richards, *Anesthesiology*, 2: 1, 37–43, January, 1941.

[4] H. A. Campbell, W. K. Smith, W. L. Roberts and K. P. Link, *Jour. Biol. Chem.*, 138: 1, 1–20, March, 1941.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN APPARATUS FOR CONCENTRATING SERUM

WITH the current large-scale use of human serum, in both military and civilian medicine, the desirability of concentrating the serum has been manifest, both in order to economize storage space and to facilitate treatment. With the apparatus to be described we have found it practicable to store the equivalent of 250 cc of serum in a 100 cc bottle rather than in the 500 cc bottle previously used.

Concentration may be effected by evaporation through a Cellophane tube supported by a special glass bell (Fig. 1). Seamless tubes of Cellophane,

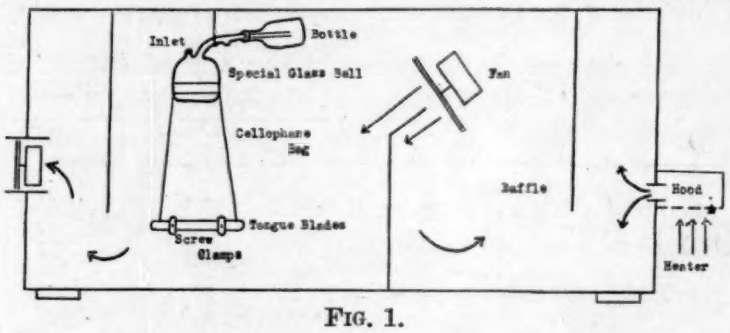

FIG. 1.

known commercially as sausage casings, are used as containers for evaporation. These tubes are cut into 12-inch lengths and the bell is inserted in one end. It is made secure with a one-half inch strip of tape drawn tightly over the adjoining surfaces. The bottom of the tube is closed by folding the bag over a strip of wood. (Tongue blades are excellent strips for this purpose.) This in turn is folded once more and additional tongue blades are securely fastened on each side with screw clamps. To maintain a closed system, the inlet is sealed with a "mushroom" vaccine stopper. The side arm of the bell is wrapped with cotton and inserted into the neck of a 100 cc storage bottle (Kimble vaccine bottle). The cotton forms a bacteria-proof seal between the side arm and the bottle. Paper is then wrapped around the joint to further insure sterility. This entire closed system, consisting of Cellophane bag, glass bell and storage bottle, is autoclaved as a single unit.[1] Serum is introduced into the Cellophane bag through the inlet and the unit is suspended in a vertical position in the cabinet.

The concentrating cabinet is 4 feet long, 1 foot wide and 2 feet high. The individual units are suspended from hooks situated as shown in the diagram. A cabinet of these dimensions will accommodate twelve units.

The cabinet is so constructed that a constant volume of warm air is blown over the Cellophane surfaces. The incoming air is warmed by a "Fletcher Radial" gas burner. The heating unit is covered with a metal hood that is equipped on the under surface with a screen. The flames from the burner pass through the screen (A), but do not go beyond the hood. With this arrangement, air is adequately heated before it enters the cabinet. A constant current of air is maintained by an exhaust fan situated at the opposite end of the cabinet.

It is important that the air brought in at the intake shall be thoroughly mixed with the air in the cabinet in order to insure an even temperature on all the drying surfaces. This has been accomplished by installing three baffles and an electric fan within the cabinet. The fan is so situated that part of the air is blown directly on the bags and the remainder mixes with the incoming air from the first compartment.

We have tried numerous types and arrangements of the baffles and have found the one shown in the accompanying diagram to be the most satisfactory in producing a uniform temperature.

The Cellophane tube as described will handle a volume of 250 cc of serum. By experimenting it has been found that a cabinet temperature of 60° C. will give a fluid temperature in the Cellophane tubes of approximately 30° C. At this temperature, water is removed at a rate of 25–30 cc per hour and concentration to one fourth the original volume is effected in six to eight hours.

After the desired amount of water has been removed, the bag is inverted and the concentrate allowed to flow into the bottle. The bottle is then aseptically sealed with a vaccine stopper and stored in a frozen state.

The apparatus also lends itself readily to the concentration of other biological products.

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[1] When sausage casings are autoclaved and allowed to dry they become brittle. In order to prevent this, we wrap the entire unit in a towel before autoclaving. This retains enough moisture to prevent cracking.

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